The Impact of Endowment Heterogeneity and Origin on Public Good Contributions: Evidence From the Lab

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Abstract

Recent experimental research suggests that unpredicted behavior in the lab may result from endowment distribution and origin. We design an experiment to explore the impact of heterogeneous endowments and earned endowments on observed contributions in a linear public good game. Our results suggest that contribution levels were significantly lower when groups had heterogeneous rather than homogeneous endowments, with this finding being independent of the origin of endowment. We did not find, however, that the lack of free-riding in public goods experiments was an artifact of endowment origin. Group members contributed about the same to the public good whether their endowments were earned or not.

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1. Introduction

Rational choice theory says people free ride in the voluntary provision of a public good. The dominant strategy is for each person to make zero contributions in a linear public good game, but evidence from the lab suggests otherwise. Most people do not free ride; they make positive though suboptimal contributions to the public good (e.g., Ledyard, 1995, Ostrom, 2000). Some researchers have attempted to capture this behavior by extending theory to include notions of fairness and reciprocity (e.g, Rabin, 1993; Bolton and Ockenfels, 2000; and Fehr and Gächter, 2000a,b); while in related game-theoretic settings, others contend that such behavior may arise from faint concerns of self-interest (e.g., Baik et al., 1999; Hoffman et al., 1994; Forsythe et al., 1994).

The ambiguity has led some researchers to ask if either the homogeneity or origin of endowments or both within public good games could affect how people adhere to the predictions of rational choice theory. While researchers recognize that homogeneity of wealth is an obvious abstraction from reality employed to gain tractability, experimental investigations into how people make contributions within heterogeneous groups is relatively sparse. In his review of public good experiments, Ledyard (pp. 158–160) lists five experimental papers and tepidly concludes that heterogeneity, at least when information is complete, tends to decrease contributions. Also, evidence suggests that people with high incomes contribute less than what theory predicts for non-linear public good games while those with low incomes contribute more (also see Chan et al., 1996). In contrast, although Chan et al. (1999) observe mixed behavior in comparing heterogeneous versus homogenous wealth, they conclude heterogeneity has a positive effect on aggregate contributions. But interaction effects exist between communication and information in their experiment that confound the strength of their conclusion.

Regarding endowment origin, economists and psychologists have long argued that the origin of wealth influences individual behavior. Friedman's (1957) permanent income hypothesis, for instance, is an early conjecture that behavior varies over wealth from different sources, but the evidence from the lab is mixed. Some researchers find evidence that the origin of assets does not influence subject behavior in laboratory settings (e.g., Clark, 1998, 2002; Rutström and Williams, 2000; Ball et al., 2001). In contrast, other work provides evidence that asset origin does alter a person's marginal propensity to consume and take risks, with windfall (i.e., unearned) endowments leading to more generous and risky behavior (Keeler et al., 1985; Arkes et al., 1995; Thaler and Johnson, 1990; and Keasey and Moon, 1996). People act more munificently and take more chances when spending "other people's money."

The dictator game exemplifies the context in which asset origin affects behavior (see Hoffman et al., 1996; Ruffle, 1998; Konow, 2000). Recall the dictator game is a one-stage, two-player bargain in which rational choice theory predicts the dictator makes zero contributions to others, as in the linear public good game. Cherry et al. (2002), for instance, uncover the strongest impact of asset origin when anonymous dictators must earn their endowment prior to the bargain. They report the rate of positive offers falls to 5 percent from the typical 40–50 percent when anonymous dictators *earn* their endowments. They conclude the linear public goods game is another context in which subjects deviate from the predicted zero contribution outcome, and they speculate whether "windfall wealth might

explain the lack of free riding in the provision of public goods in the laboratory." This implies that people might act less generous to other contributors when asked to donate earned money to the public good.

Herein, we explore the impact of endowment heterogeneity and origin in public good experiments. This paper rejects the thesis that the positive contribution behavior observed in linear public goods games is an artifact of asset origin. Our experimental evidence suggests that the origin of endowments did not matter—subjects contributed about the same level regardless of whether their wealth was earned or windfall. We do find that contributions fall significantly, however, once wealth was heterogeneous within a group of contributors. The average person within a heterogeneous group contributes less relative to one in a homogenous group, but contributions were still independent of the source of wealth. Subjects with high endowments contributed significantly less when they were in heterogeneous groups, an observation suggestive of an anticipated reciprocity effect that does not exist in the dictator game.

2. Experimental design

Our design uses a classic linear public good game, in which earned and windfall endowments are the treatments (T1 and T2). The experiment had two stages – *earnings* and *public good contributions* – each with a written protocol.[1] Consider first the earnings stage. In treatment T1 we follow Cherry et al. (2002). Each subject earned money by taking a quiz containing 17 questions taken from the sample section of the Graduate Management Admission Test (GMAT).[2] The amount earned was determined by the following rule: if a subject answered at least 14 questions correctly, he or she would earn $40; between 11 and 13 questions, $30; between 8 and 10, $20; and fewer than 8, $10. Subjects knew they had 45 min to complete the quiz and that the monitors would collect and grade the quizzes and inform them of their cash earnings in confidence. In treatment T2, the endowment was a windfall. Here a monitor randomly allocated the four endowment levels by the order subjects entered the room.

Second, the public good contribution game was identical in T1 and T2. Four subjects are grouped into a collective without knowing the identities of the other group members. Each subject in a group receives an *endowment sheet* showing (a) his or her own endowment according to the earnings rule, and (b) the endowments of the other three group members. The groups were either homogeneous (e.g., all four had a $30 endowment) or heterogeneous (one subject from each endowment level, $10–$40). Each person in a group then decides individually how to divide his monetary endowment between a private account and a public

[1] The monitor read the instructions aloud and administered a control questionnaire to make sure the subjects understood the instructions. The full instructions, as is the raw data, are available on this journal's website.

[2] The use of a quiz follows previous work (e.g., Hoffman et al., 1996; Clark, 1998; List and Cherry, 2000), though other studies have employed various measures of effort: preparing letters (Konow, 2000), solving a computerized puzzle (Rutström and Williams, 2000), finding a way through a computerized maze (Gneezy, 2003) and cracking walnuts (Fahr and Irlenbusch, 2000). These papers, however, do not compare outcomes in treatments with real effort to those without effort.

account. All money placed in one's private account is private earnings; money placed in the public account is multiplied by 2 and divided equally among the group members, independent of whether a member had contributed to the public account. While the social optimum is for each subject to contribute his entire endowment to the public account, the Nash equilibrium is for each person to put his entire endowment into his private account. The public good game was played only once to remove any beliefs that generosity in one period could trigger reciprocal behavior by other group members in a future period. After the experiment was completed, subjects exited the lab and returned one hour later to collect their earnings.

One hundred and twenty-four students from St. Lawrence University participated in four sessions.[3] No subject was an economics major or had previously participated in a public goods experiment. Depending on the treatment, the sessions lasted either 40 or 90 min including reading the instructions. The average compensation for each subject was $34.78, with a range of $9–$82.50.

3. Results

We first review subject behavior at the aggregate level to examine the impact of endowment heterogeneity and origin on public good contributions. Table 1 provides subject contribution rates by treatment and endowment level. First examining endowment distribution, tests of proportions reveal that subjects acting in groups with heterogeneous endowments contribute less to the public good relative to those in groups with homogeneous endowments, 10.50 versus 7.16 ($t = 1.977$). While still apparent, the result is weakened by testing the contribution as a percentage of endowment, 42.1 percent versus 33.1 percent ($t = 1.47$). This result emerges whether the endowment was allocated or earned, 10.22 versus 6.56 when endowments were allocated and 10.82 versus 7.75 when endowments were earned.

Turning to the impact of endowment origin, the data indicate that contribution levels do not significantly differ for subjects who earned their endowment relative to those with windfall endowments; 8.39 versus 9.18 comparing absolute contributions ($t = 0.46$) and 38.3 percent versus 36.6 percent comparing relative contributions ($t = -0.28$). This result emerges whether subjects are acting within groups with homogeneous or heterogeneous endowments, 10.22 versus 10.82 in homogenous groups and 6.56 versus 7.75 in heterogeneous groups.[4]

Now consider a conditional analysis of individual decisions to confirm our interpretation of the aggregate numbers. Table 2 shows the results from the following empirical model of

[3] We recruited more than 124 subjects and sent some home in the earned endowment treatment after they took the quiz. We did this to ensure we had an equally divided subject pool across the four endowment categories. Those subjects sent home were randomly chosen from the different endowment categories in each treatment and received the money they would have had as endowment had they stayed in the experiment.

[4] Interestingly, only considering heterogeneous treatments at the aggregate level suggests a possible interaction between earning and endowment effects. Conditional estimates however do not reveal a significant interaction. We thank an anonymous referee for raising this issue. The raw data, as the instructions, are provided on the journal's website.

Table 1
Average absolute and relative contribution to the public good by endowment attributes

Endowment level	Allocated			Earned			Earned and allocated		
	Homogeneous	Heterogeneous	Homogeneous and heterogeneous	Homogeneous	Heterogeneous	Homogeneous and heterogeneous	Homogeneous	Heterogeneous	Homogeneous and heterogeneous
10	5.00 (50.00)	6.50 (65.00)	5.75 (57.50)	4.25 (42.50)	4.25 (42.50)	4.25 (42.50)	4.75 (47.50)	5.38 (53.75)	5.10 (51.07)
20	9.38 (46.88)	5.75 (28.75)	7.56 (37.81)	9.50 (47.50)	4.13 (20.63)	6.81 (34.06)	9.44 (47.19)	4.94 (24.69)	7.19 (35.94)
30	11.25 (37.50)	6.50 (21.67)	8.88 (29.58)	11.00 (36.67)	13.25 (44.17)	12.13 (40.42)	11.13 (37.08)	9.88 (32.92)	10.50 (35.00)
40	15.25 (38.13)	7.50 (18.75)	11.38 (28.44)	15.25 (38.13)	9.38 (23.44)	12.31 (30.78)	15.25 (38.13)	8.44 (21.09)	11.84 (29.61)
All levels	10.22 (43.13)	6.56 (33.54)	8.39 (38.33)	10.82 (41.01)	7.75 (32.68)	9.18 (36.57)	10.50 (42.14)	7.16 (33.11)	8.77 (37.48)

Top number represents the absolute contribution in $ terms while the number in parentheses is the relative contribution (percent of endowment).

Table 2
Absolute and relative contribution models

	Contribution	
	Absolute[a]	Relative[b]
Earned	0.670 (0.682)	−0.784 (0.897)
Homogeneous	3.139 (0.057)	9.658 (0.114)
Endowment	0.227 (0.003)	−0.658 (0.019)
Constant	1.139 (0.620)	49.945 (0.000)
N	124	124
F	4.64 (0.004)	2.66 (0.062)

[a] Dependent variable is the absolute dollar amount contributed.
[b] Dependent variable is the percentage of endowment contributed *p*-values are in parentheses.

contribution levels:

$$C_i = \alpha + \phi_i + \omega_i + \psi_i + \varepsilon_i,$$

where the dependent variable, C_i, denotes the ith subject's contribution to the public good, ϕ_i captures whether the endowment for subject i was earned or allocated, ω_i captures whether the members of subject i's group had homogeneous or heterogeneous endowments, ψ_i measures the absolute endowment level of subject i, α is the constant term and ε_i is the contemporaneous additive error term. We estimate two contribution models—*absolute* dollar contributions and *relative* contributions as the percentage of a subject's endowment.

The conditional estimates match our initial impressions. In both the absolute and relative contribution models, no significant difference exists in behavior between subjects who earned their endowments and those who received a windfall. The earnings result is robust with estimates being conditioned on wealth levels and whether the subject was in a homogeneous or heterogeneous group.

We do find, however, that when earnings were heterogeneous within a group, our subjects contributed significantly less to the public good than those in groups with homogeneous endowments. The level of wealth has a significant positive relationship with contributions in absolute dollars and a significant inverse relationship in real terms (% of wealth). These two findings correspond with Ledyard's restrained conclusion that heterogeneous endowments might decrease contribution levels and Chan et al.'s (1996, 1999) observation that people with high incomes under-contribute and those with low incomes over-contribute relative to the rational benchmark in a non-linear public goods experiment. Although our earnings protocol replicated the Cherry et al. design, the results differ, suggesting that the influence of asset origin could be context dependent.[5] Relative to anonymous dictators, subjects acting in the public goods game faced a more complex task that demanded greater cognitive effort and involved simultaneous decisions by other contributors. Our finding that high income subjects contributed less in heterogeneous than homogeneous groups suggests an

[5] This result is consistent with Clark (2002), who found that subjects did not behave differently in a public good game when they provided their own endowment. Bosman and van Winden (2002) observed in a power-to-take game that take rates by the first movers were not significantly different in the treatments with and without real efforts, but second movers destroyed less often their own and the first movers' incomes in the real-effort treatment.

"anticipated reciprocity" effect: subjects contributed more when others were also able to contribute more. Rather than being viewed as being generous with their earned wealth, subjects seemed to expect a reciprocation of their contributions. This notion of anticipated reciprocity is consistent with the "conditional cooperators" idea discussed in Fischbacher et al. (2001). They find that 50 percent of all subjects were willing to contribute more to the public good when they believed (i.e., anticipated) that the others players would contribute more as well (i.e., reciprocate). The difference to our experiment, however, is that in their study everybody had the chance to contribute on all levels, which is not the case in ours. That is, a conditional cooperator is willing to contribute *high* if everybody else does and *low* if everybody else does—she does little when she knows the others will not reciprocate even though they could. In our experiment, a subject with high endowment in a heterogeneous group will do little since she knows the others with small endowments will not reciprocate because they cannot.

4. Concluding remark

People in the lab voluntarily contribute more to the public good than theory predicts. Based on previous lab work, two explanations have been suggested to explain this discrepancy: the origin and the distribution of wealth. Windfall wealth can lead to more generosity and risk taking (e.g., Cherry, 2001), whereas ex ante heterogeneous groups or people confronting ex post heterogeneous payoffs are more likely to act more self-interested (e.g., Sutter and Weck-Hannemann, 2003; Shogren, 1997). We test whether either heterogeneity of wealth or the origin of wealth (or both) affect contributions in a public good game. We find the origin of wealth did not matter to contribution levels in a linear public goods game. People contributed the same irrespective of whether wealth was windfall or earned. But we do see that contributions fell when earnings were heterogeneous within a group. This heterogeneity result is consistent with an "anticipated reciprocity" effect, in which people act as if they expect others to contribute too, which may dominate any influence from the origin of wealth.

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Further reading

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